

Yasuhide Fukumoto

[Co-author

Felix Kaplanski (Tallinn University of Technology) H. K. Moffatt (University of Cambridge)]

Title:

Global time evolution of viscous vortex rings

Abstract:

Initial-value problems are solved, at both small and large Reynolds numbers, for an axisymmetric vortex ring embedded in a viscous fluid.

They produce, respectively, lower and upper bounds on traveling speed, in an early stage, for a vortex ring starting from an infinitely thin core, which substantially improves Saffman's formula (1970). At large Reynolds numbers, the viscosity plays only a secondary role. Kelvin- Benjamin's kinematic variational principle, as adapted for our purpose, facilitates calculation of a higher-order correction. For a small-Reynolds-number motion, the vorticity is obtained over the whole time range from the Stokes equation. A simple relation of the maximum distance traversed during the whole life is found with the viscosity, the initial circulation and ring radius.